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Ohio

AGRICULTURAL EXPERIMENT STATION . . . WOOSTER, OHIO

presents

POINSETTIA DAY

Thursday, November 30, 1961

CHECK THE TIMING OF YOUR POINSETTIAS

Robert O. Miller
Ohio Agr. Exp. Sta.
Wooster, Ohio

The following photographs of the weekly development of poinsettia bracts should give you an idea of what to expect of your plants this fall whether lighted or not lighted. All plants are "Barbara Ecke Supreme" which were rooted directly in small peat pots. Cuttings were taken September 1 and panning was done October 10. The plants on the left in each photograph received two hours of incandescent light from 60 watt bulbs four feet apart and four feet above the plants from September 22 to October 10. Plants on the right received natural daylight at Wooster, Ohio, during this period and all plants received natural daylength after October 10. Plants grew in a 62°F minimum night temperature greenhouse. Day temperatures were 67°F or higher depending on light and outdoor temperatures.

Fig. 1. Photographed November 11, 1959, showing well formed buds on the unlighted plant. A color photograph of these same plants reveals no color yet on the unlighted plant.

Fig. 2. Photographed November 18, 1959. A color photograph of these same plants gives evidence of a slight amount of red color forming on this date. Note that all top bracts of the unlighted plants are showing color.

Reprinted from Ohio Florists Association Bulletin No. 386.

Fig. 3. Photographed November 25, 1959. The upper bract on the lighted plant on the extreme left is about one-half red while the other small bracts are still mostly green. Note the advanced stage of bud development in the unlighted plants.

Fig. 4. Photographed December 2, 1959. Note that color is quite evident in the upper bracts of lighted plants. The buds are about the size of large B-B shot.

PROGRAM FOR POINSETTIA DAY

Ohio Agricultural Experiment Station
Wooster, Ohio
November 30 (Thursday) 1961

Morning Program: Horticulture Greenhouses, Rear of Gourley Hall.

9:00 - 10:00 A.M. Register, view the exhibits, and get acquainted. Enjoy coffee and donuts.

10:00 - 12:00 noon Tours of the research in progress, both at Columbus and Wooster. Projects with snapdragons, geraniums, pot mums, as well as poinsettias will be discussed. Results with CCC, effect of daylength, temperature, date of propagation, and variety experiments with poinsettias will be covered.

12:00 - 1:30 P.M. Lunch. Those wishing a catered box lunch at the greenhouse must reserve one by November 27 by writing to Robert O. Miller, Department of Horticulture, Ohio Agr. Exp. Sta., Wooster, Ohio. The cost will be $1.35 payable at registration. Avoid the trip "downtown" and have more time to see the exhibits by having lunch at the greenhouse.

Afternoon Program: Horticulture Greenhouse

1:30 - 3:15 P.M.	Welcome to the Station	Dr. Roy M. Kottman Director of the Experiment Station
	Research in Floriculture	Dr. Freeman S. Howlett Head, Department of Horticulture
	Results of CCC Research	Dr. D. C. Kiplinger Department of Horticulture
	Results of Temperature and Daylength Research	Dr. Robert O. Miller Department of Horticulture
	Questions and Answers	Prof. James L. Caldwell Ohio Agricultural Extension Service

3:15 - 5:00 P.M. Horticulture Greenhouse. Take this time to get a second look around the greenhouse. The staff will be on hand to discuss the research. Remember that research at Columbus as well as Wooster will be set up for all to see.

Anyone desiring motel reservations should contact Robert Miller.

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WHERE ARE WE - AND WHY - WITH POINSETTIA RECOMMENDATIONS

Robert O. Miller
Ohio Agricultural Experiment Station
Wooster, Ohio

Many problems have faced poinsettia growers - and thus research workers - regarding the culture of poinsettias in the past 10 years. Many problems yet remain; however, as a result of constant attack of these problems both by growers and research workers, a cultural program has been generally established. What has guided the evolution of this general cultural program in recent years? What has influenced University and Experiment Station workers in such a way that the great majority advocate - except for minor provisions - essentially the same cultural program? And finally, what will dictate the general direction of cultural research at least in the near future?

I would like to give an answer - my opinion - to these three questions now,and then attempt to point out the reasons for that answer. Stated simply - perhaps too simply - the answer is that poinsettia root rots have influenced nearly every major step forward in poinsettia culture in recent years. Today, root rot organisms are the limiting factor for poinsettia production in most sections of the Northeast. Profitable production depends on control of these diseases.

In order to appreciate how general cultural practices are influenced by these diseases, it is necessary to know something about how they operate.

Rhizoctonia solani is the organism which often causes the stem rot disease showing up sometimes in the cutting bench, sometimes in small pots prior to panning and, frequently, shortly after panning. Research has shown that this organism causes a disease likely to be most severe when the temperature is relatively high and when the soil is "on the dry side". After cooler temperatures prevail - in November and December - Rhizoctonia does not usually cause too much trouble. This particular organism, as the others to be mentioned, can be controlled by a complete and strict sterilization and sanitation program. In addition one of the important control measures for this organism is the use of PCNB (Terraclor) as a soil drench to inhibit organism growth should recontamination of the soil occur.

Thielaviopsis basicola is an organism quite different from Rhizoctonia, both in point of attack and in conditions which favor disease severity. Thielaviopsis, or the black root rot organism, can cause damage at all times of the year - in the cutting bench, the small pots, as well as finishing pans. Thielaviopsis attacks the roots of the plant and occasionally, in severe cases, the stem. In the first stages, black flecks or streaks are evident on infected tissue, hence the name, "black root rot". As the disease advances, however, the whole root rots and the distinctive symptoms are no longer evident.

Research has shown that disease severity is usually greater as a result of infection with this organism when temperatures are relatively low and when soils are kept wet. Most damage would therefore be expected towards the end of the season and this has proved to be true. Control of this organism at present depends on a complete sterilization and sanitation program and good management. Unfortunately, no chemicals are available which can materially supplement control by sterilization and sanitation as is true with Rhizoctonia stem rot.

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Pythium is the third organism capable of causing severe losses. The effect of Pythium is much like Thielaviopsis - rotted roots develop with the rot often extending well up the stem. Here again losses can occur at any time during the season but most often disease severity is greatest when low temperature and wet soil conditions prevail. Further, control measures do not differ appreciably from those needed for Thielaviopsis - sterilization, sanitation, and good management. Fungicides offering control of this organism specifically are being tested and will be mentioned later.

Now that the organisms causing root rots have received brief attention, let us look at how they have influenced culture. First, the basic recommendation for the control of these diseases is based on eliminating them from the growing area by sterilization and keeping them out by a sanitation program. This can be accomplished - at least in theory - because these organisms do not float about in the air like bread molds or Botrytis. They must be carried in bits of soil, debris, dirty tools, contaminated hose ends, etc. A major effort must be made to prevent recontamination by these organisms. Contamination can occur, however, and in the majority of cases does occur. This then is where the story really begins as to how cultural recommendations have evolved around the necessity of root rot control.

In the early 1950's A. W. Dimock and Kenneth Post at Cornell University found that Thielaviopsis caused a severe disease of poinsettia and this disease was especially aggravated by low temperatures. For example, Post stated that root growth was poorer at 60°F than it was at higher temperatures. Dimock stated that "If.....the young plants and pans were held at high temperature until leaf and bract formation were well along, and the temperature was lowered to hold the plants back for Christmas, root growth would be restricted, Thielaviopsis rot would continue or perhaps accelerate and the plants might well respond by yellowing and dropping their leaves." Dimock went on to stress the importance of sterilization and sanitation.

As a result of these researches, growing temperatures, especially late in the season, were increased as growers found the practice paid dividends in terms of better crops. As the use of growing temperatures near 60 and 62°F minimum at night right up to the time of sale became more prevalent, it became increasingly clear that although late season root rots - caused by Pythium as well as Thielaviopsis - were definitely less of a threat, a new problem had been created. As a result of higher growing temperatures bract development was speeded and therefore flowering was early.

Instead of flowering near December 20, crops growing at 60 to 62°F were in flower as early as Thanksgiving some years and almost always at the end of the first week of December. Early flowering for most plants sold is undesirable. The bracts begin to droop by the time of sale, pollen, stamens, and cyathia begin to shed creating an unpleasant chore for the housewife, and nectar secretion becomes excessive further detracting from the appearance of the bloom. In short, plants flowering in early December are nearly ready for the trash can by the time they reach the consumer. And then the question is, will the consumer buy again if she feels she got an inferior plant?

Research was ready with an answer to the question of early flowering. Garner and Allard, who discovered photoperiodism and reported their work in 1920, had shown that poinsettias were short day plants and that long days prevented flowering. Based on these results and further work, it was suggested that artificial light be used to prevent poinsettias from initiating flower

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buds until such a time that flowering occurred near the time of sale. This artificial light period necessary to delay flowering has been found to be roughly between September 20 and October 5 to 10 depending on desired results. By providing long days during this period, the start of bud initiation is prevented until the lights are turned out. Flowering then occurs near the 20th of December if temperatures near 62°F are maintained. It is not meant to imply that there is no need for early flowering poinsettias for business establishments, etc., but by far the big demand is for the home to be delivered three or four days before Christmas.

So research provided the answer to early flowering caused by growing at higher temperatures which research had shown greatly reduced the injury due to late season root rots. But still another problem resulted: often lighted plants were taller than desirable.

The combination of reduced root rot (because of higher temperatures) with resultant vigorous growth and, perhaps more importantly, the additional two to three weeks available for vegetative growth in height between September 20 and October 5 to 10 often resulted in plants too tall to command top price. In other words, the growing period between date of propagation and the start of short days was too long. So, just as with chrysanthemums, the schedule had to be shortened. Instead of ordering cuttings for later delivery as with mums, however, cuttings had to be taken later. This sounds simple enough. In order to take cuttings later, though, cuttings have to be on the stock later. This created problems of stock management which have been mostly solved as a result of work at Maryland by Shanks and Link. Even though a bulk of the cuttings are taken in very late August and early September there are some early cuttings to provide material for larger pans and also considerable numbers of later cuttings in late September and early October.

A hint as to how to utilize these later cuttings was gathered from earlier observations of growth at high temperatures by Post and others. They noted that growth was much greater at higher temperatures but that flowering was inhibited or delayed at these temperatures. The problem, then, was one of making use of the beneficial effect of high temperatures (65 to 70°F) on vegetative growth yet avoid the deleterious effects on bud initiation. The use of black cloth shade to artificially shorten the day to cause flower initiation in plantings grown at high temperatures came about as a result of studies which showed that as the temperature increased, the critical daylength for flower initiation decreased. That is, a shorter day was necessary to cause bud initiation at 70°F than at 60°F. The idea behind recommending black cloth for late cuttings, then, is to make it possible to get the benefits of greater growth at high temperature yet still not have delayed flowering. Shade is suggested for crops grown at 65 to 70°F but not at 62°F since natural daylength is sufficiently short at 62°F.

The reasons for current recommendations have been briefly outlined above. Are we stuck with these rather complicated suggestions? The answer is yet to come but it may well be NO! It should be pointed out, though, that even if high temperature growing, lighting, late propagation, and shading to produce short high quality plants could be dispensed with tomorrow, many growers would still use the practices because quick uniform crops are the result. Rather than caring for the crop from late June to December, the months of June and July and early August can be largely free of poinsettia propagation and small plant handling.

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Let us take a look at the future now that we have reviewed the past. What developments may be important in the immediate years to come?

In my opinion the most promising new research is being done with new chemicals. In both instances, benefits to the grower may be quickly apparent. One of these chemicals, CCC (2-chloroethyltrimethyl ammonium chloride) is a growth inhibitor acting on poinsettias much like Phosphon does on chrysanthemums. Applications of this material to poinsettias apparently reduces growth of the internodes without greatly affecting leaf numbers or flowering date. Leaf color has been improved, although leaf size is reduced. In general the plants are of very satisfactory appearance. Trials in Ohio with propagations during the season from June through September have indicated that satisfactorily short plants can be obtained from June and July propagations by using CCC even though vigorous growth is maintained by adequate water and fertilizer. Much has yet to be learned about the material but it does show definite promise in the hands of the careful grower.

Let us see how this material will help growers. Thinking back to what has been said about height control and the measures necessary to produce high quality plants, it is evident that CCC will, even if it can be used commercially, not solve all problems. As far as we know flowering is not affected; therefore, we might expect that it will still be necessary to use lights to prevent early flowering. Since CCC will keep the plants short, however, the use of lights will not result in excessively tall plants. CCC will not affect root rot so "high" temperature growing will still be necessary.

Another material, as promising as CCC is being tested at various universities. This material is called Dexon and it is apparently a very effective material for the control of Pythium and closely related organisms. Although this material does not control Thielaviopsis it does offer some hope of reducing injury from late season root rot caused by Pythium. To go as far as saying that Dexon would solve all root rot problems would be foolish but its use and use of specific materials like it might allow more leeway in growing temperatures in the future. If this proves to be true, a re-evaluation of current recommendations may be necessary.

Upon the above general considerations, research was initiated to formulate a set of precise recommendations for commercial poinsettia production. These recommendations are attached to this article.

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OHIO RECOMMENDATIONS FOR TEMPERATURE AND SUPPLEMENTAL LIGHT ON POINSETTIAS

D. C. Kiplinger,* Robert O. Miller,* and James L. Caldwell**

Poinsettia growers are interested in the economical production of the highest quality plants. Important factors in this respect are the manipulation of temperature and light. The loss of plants from root rot at cooler temperatures has forced the growers to raise the greenhouse temperature which in turn has hastened maturity. Lighting to delay flower bud initiation is a practical solution to this problem, and the use of intermittent mist plus rooting direct in pots has greatly reduced the time required for propagation and ultimate growth of the plants. Consequently, it is important to bring together the results of several years work on temperature and light to help growers produce better quality plants for the consumer.

The following recommendations for the variety Barbara Ecke Supreme are for Ohio or other areas where conditions are similar.

Stock Plants

1. If cuttings are taken up to September 25, the stock plants need not be lighted.

2. If cuttings are taken after September 25, the stock plants should be lighted for 1 hour per night (11 P.M. to 12M or 12 M to 1 A.M.) beginning September 25 until the last cuttings are taken. If cuttings are taken after September 25 from unlighted stock plants, buds are forming and slow or uneven rooting may be experienced as well as failure of many of the plants to become established in pots.

Cuttings

The following statements apply to cuttings rooted in a propagation bench in any satisfactory medium where rooting takes place in approximately 21 days or less. Intermittent mist is helpful in promoting rooting but bottom heat may have to be provided earlier to prevent cooling of the medium from the water. Recommended rooting mediums are coarse well-drained sand, equal parts of sand and peat, Perl-lome Special, equal parts of Perl-lome Special and peat, or a mixture of equal parts of soil, coarse sand, and peat.

1. Cuttings taken up to September 10 should be lighted for 1 hour per night from September 25 to October 5 to prevent early maturity. Plants from these cuttings should be kept at 60° to 62°F in October, November, and December.

2. Cuttings taken from September 10 to September 25 need not be lighted because they will flower at Christmas if grown at 60° to 62°F.

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3. Cuttings taken after September 25 should be lighted in the propagation bench until rooted (see stock plant lighting) or until October 15 whichever is first. Some evidence exists that black cloth applied for 3 weeks after lights are turned out will hasten flowering and improve bract form. The minimum night temperature for growing the plants should be 65°F. Lighting the stock plants and the cuttings will prevent flower bud formation which interferes with subsequent growth, and the high temperature insures rapid development.

The following statements apply to cuttings rooted either in peat or clay pots under intermittent mist. These cuttings develop faster because there is no check in growth from lifting, potting, or getting established.

1. Cuttings taken before September 1 should not be rooted in pots since they will grow too tall, unless you intend to use them for stock, pinched plants, or large specimen pans.

2. Cuttings taken September 1 to September 20 should be lighted from September 25 to October 5 and grown at 60° to 62°F. If not lighted, many will flower too early.

3. Cuttings taken from September 20 to October 1 should be lighted from September 25 in either the propagation or growing-on bench until October 15 and grown at a minimum night temperature of 65°F. Lighting during the rooting period prevents flower bud formation which interferes with subsequent growth, and the high temperature insures rapid development. Some evidence exists that black cloth applied for 3 weeks after lights are turned out will hasten flowering and improve bract form.

4. Cuttings taken after October 1 should be lighted until October 15 and grown at a minimum night temperature of 70°F. Black cloth treatment as previously indicated should be used here. Don't be surprised if this group of plants doesn't make it because of lack of time to develop.

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POINSETTIAS

Can be kept short with a growth inhibitor

D. C. KIPLINGER and ROBERT O. MILLER

One of the problems confronting the florist who grows poinsettias is keeping the plants reasonably short. The greatest demand is for three single stemmed plants in a six-inch pot with the height varying from 10 to 18 inches above the pot rim.

Propagation of the plants by cuttings taken late in the season is, of course, a method of controlling height by virtue of limiting the time allowed for growth, but it is not always possible to get enough cuttings in this rather short period.

Recently, a growth inhibitor called CCC (2-chloroethyl trimethyl ammonium chloride) has been found to inhibit internode elongation of a number of plants. It appeared that if this material were applied to early propagated plants, they would not "stretch" and become unduly tall.

A test was run using rooted cuttings sent air freight from a California propagator at two-week intervals beginning on July 20 and continued until late September. The cuttings were placed in three-inch pots upon arrival and two weeks later differential amounts of CCC were applied to the soil in which the plants were growing. Fifty cubic centimeters of water containing the desired amount was just sufficient to almost moisten the entire soil mass. The plants received this one application only.

Since poinsettias are commonly sold as three plants in a six-inch pot, potting in this size container

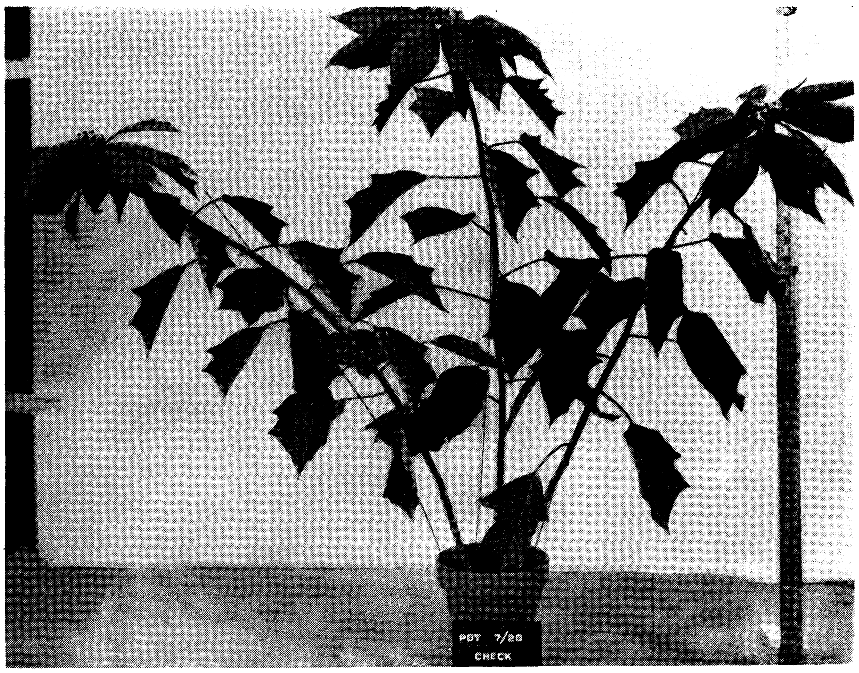

Fig. 1.—Untreated plants, too tall for most purposes.

Fig. 2.—Plants treated with ¼ gram of CCC; growth reduced, but still too tall.

was started on the earlier propagated plants in early October in order to have specimens that would approximate commercial florists stock.

Treatment with CCC did not consistently delay flowering and the plants flowered much too early for the Christmas market. A few plants in each of the plots were lighted for one hour each night from September 25 to October 5 which prevented early flowering.

The diameter of the red bracts which are the showy part of the plants was smaller in treated plants. This was not too objectionable on the early propagated plants except for the one gram treatment, but on the other groups of plants, the bract size on these receiving CCC was noticeably smaller than on the untreated plants.

The height of the treated plants was considerably shorter as a result of only one CCC application. Plants which received ½ gram of CCC were only about one-half as tall as those not treated.

Treatment with CCC caused the new leaves to become a very dark green which enhanced the appearance of the plants. The leaves on treated plants were smaller and the internodes were shorter, the latter being responsible for the reduced height. The 1 gram rate caused marginal yellowing of the older foliage and the use of that amount of CCC would not be recommended.

All of these tests involved only one treatment with CCC. When the early propagated and treated plants were potted in the finishing pot, the roots grew into soil that had not been treated with CCC, and soon the new growth had internodes of normal length. It is apparent that a treatment while in the small pots and a repeat treatment both at the ½ gram rate, as soon as the plants were established in the finishing pot would keep even the earliest propagated plants short. Lighting is recommended in order to prevent early flowering on such early propagated plants (cuttings taken prior to September 10).

Because of the promising nature of CCC in reducing the ultimate height to which early propagated poinsettias will grow, further experiments are planned.

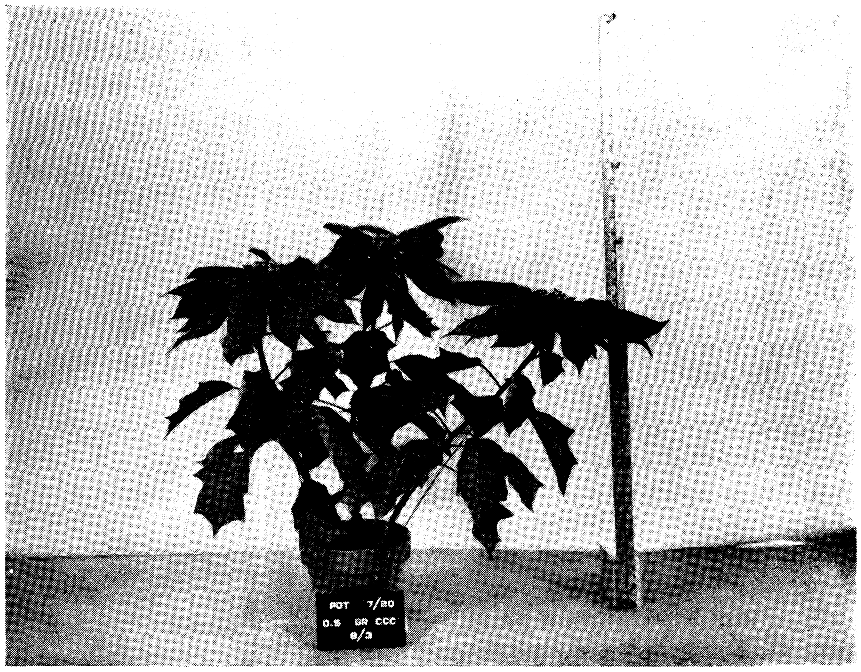

Fig. 3.—Plants treated with ½ gram of CCC; although a little tall, this is a good commercial quality specimen.

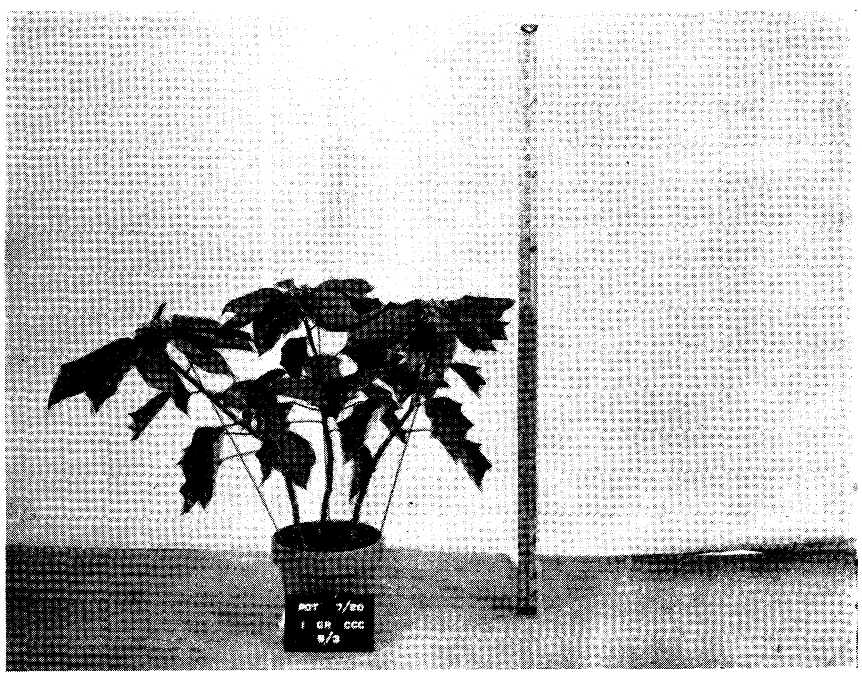

Fig. 4.—Plants treated with 1 gram of CCC; although short, note the loss of lower leaves associated with too strong a concentration of the growth retardant.

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KEEPING POINSETTIAS SHORT WITH CCC

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Ohio Agricultural Experiment Station
Wooster, Ohio

The most popular size of finished poinsettias is three single-stemmed plants in a 6-inch azalea pot, and any one specimen of three plants may vary from 10 to 18 inches above the pot rim to be suitable in the average home. Keeping poinsettias short that have been propagated prior to the first week in September is rather difficult unless they are checked in growth by carrying the soil extremely dry, starving the plants, and/or placing the plants outside where the environmental conditions do not favor stem elongation. Plants handled in this way will be short but loss of lower leaves is very serious and the over-all quality is reduced.

The growth-retarding chemical, CCC (2-chloroethyl trimethyl ammonium chloride) first tested at Michigan State University has been found by research workers at that institution as well as the United States Department of Agriculture to reduce the growth of many plants by suppression of elongation of internodes. Using CCC on early-propagated poinsettias appeared to be a feasible way of keeping earlier-propagated plants at a suitable height.

Tests conducted by the Ohio Agricultural Experiment Station at Columbus in 1960 have been reported in Bulletin 385 of the Ohio Florists' Association, and the general conclusions were reached that the material had considerable promise. In 1961 the tests were enlarged to provide more information on the usefulness of the compound. In addition, the Society of American Florists cooperating with the American Cyanamid Company (manufacturers of CCC) and research workers at many states established a nationwide evaluation of the material by selected members of the florist industry. At this writing neither the 1961 tests in Ohio nor the nationwide evaluation are complete, but they are sufficiently advanced so that some observations can be made and these, together with the 1960 test results, follow.

Stock Plants

Experiments by Widmer reported in the Minnesota State Florist Bulletin showed that treatment of the stock plants reduced the number of cuttings and hence was an undesirable method of treatment to prevent subsequent excessive elongation of the cuttings.

Application to Plants in Small Pots

Plants may be treated by spraying the foliage or drenching the soil, and the latter appears to be more practical method to insure equal amounts for each plant. Soil treatment can be made at regular intervals (such as each month) using relatively low concentrations and this is the method that has been used by research personnel in Horticulture at Michigan State University.

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1960 Tests

At Ohio we elected to apply the material only once to plants in small pots in order to keep labor of application at a minimum. Cuttings were supplied through the courtesy of Paul Ecke, Encinitas, California, and were sent air express every two weeks from mid-July to the last of September. The cuttings were placed in 3-inch pots and were treated two weeks after potting since in that time sufficient roots developed to absorb the material. Treatments consisted of a check or untreated plot, $\frac{1}{4}$ gram of CCC per 3-inch pot, $\frac{1}{2}$ gram of CCC per 3-inch pot, and 1 gram of CCC per 3-inch pot, each applied in 50 mls of water. All plants were fertilized at each watering with 25-5-20 at 1 oz. per 15 gallons. Panning of the earlier plants was started on October 10 and all plants were panned by October 25. The plants were not lighted and grew at a night temperature of 60°F. The results are shown in Table 1, and in each treatment there were 12 pots of three plants in a 6-inch pot.

TABLE 1--SINGLE-STEMMED PLANTS AS AFFECTED BY CCC

Potting Date	Amt. of CCC per 3" Pot	Treatment Date	Ave. Date of Flowering*	Ave. Diam. of Bracts in Inches	Ave. Height of Plants Above Pot Rim in Inches
7/20	None	8/3	11/27	11.8	33.0
7/20	1/4 gram	8/3	11/22	11.3	21.5
7/20	1/2 gram	8/3	11/24	10.9	18.7
7/20	1 gram	8/3	11/25	9.5	14.3
8/3	None	8/17	11/28	11.5	23.1
8/3	1/4 gram	8/17	11/25	9.9	15.2
8/3	1/2 gram	8/17	11/27	9.8	12.7
8/3	1 gram	8/17	11/28	9.7	11.0
8/17	None	8/31	12/2	10.3	18.0
8/17	1/4 gram	8/31	12/1	7.0	8.0
8/17	1/2 gram	8/31	12/2	6.4	7.0
8/17	1 gram	8/31	12/8	5.0	6.8

* Flowering was when pollen first appeared.

Several things are apparent from the data. First, there was little effect on the date of flowering--all plants flowered early because they were not lighted. Secondly, bract size was reduced by treatment with CCC which is to be expected since elongation or enlargement of cells is markedly suppressed in the internodes and to a somewhat lesser extent in the leaves and bracts. Of particular importance to note is that in general the later the treatment with any one concentration the smaller the bracts, and that late treatment with a high concentration markedly reduced bract size. It must be noted, however, that late treatments were made on plants propagated later.

Height was considerably shorter as a result of only one application of CCC due to reduced internode elongation which was clearly visible upon a casual inspection of the plants. Leaves on treated plants were darker green which enhanced the appearance of the plants. Treatment at 1 gram rate caused marginal yellowing and in the 1960 tests was too strong to recommend for use on small pots. The $\frac{1}{2}$ gram rate appeared to be the most satisfactory treatment. No data are presented for cuttings sent during September because the effect of CCC was so drastic in reducing the growth as to render the plants unsalable.

It was concluded from the 1960 tests that treatment of California cuttings received up to mid-August would be satisfactory.

1961 Tests

In 1961 the tests at Columbus have compared California cuttings with those of our own timed to be rooted when the shipped-in cuttings arrived. Cuttings were sent weekly by Paul Ecke beginning July 3 and continuing through September 5. All cuttings were placed in 3-inch pots and treated two weeks later when roots were well-established. Initially the plants from California cuttings were considerably shorter, but by late November the differences in height of the plants are much less marked. It should be pointed out that this is a common thing in that California cuttings are taken from stock plants growing outside and they are quite hard compared to a cutting from a stock plant under glass; hence, they do not start growing as rapidly. Furthermore, there is an additional check in growth caused by the time in transit during which the cuttings are not in the most favorable of environments.

The effect of CCC has not been as pronounced in the 1961 tests as it was the previous year. It appears that California cuttings received in late August can be treated with $\frac{1}{2}$ gram of CCC per 3-inch pot and the plants will finish at a reasonable height. Those propagated at Ohio State appear as if cuttings potted up to very early September could be treated (2 weeks after potting) and a good quality plant would develop.

One observation is very evident from the 1961 tests. Cuttings taken before July 1 are much too tall by late November even when treated with 1 gram of CCC per plant. Furthermore, cuttings potted very early become pot-bound and develop roots around the soil ball to such an extent that they do not grow satisfactorily into the new soil added at panning. Evidently the roots are restricted to such an extent that growth after panning is very slow. The plants themselves are not hard since they were fertilized at each watering and maintained the normal green color. In addition the labor of watering, fertilizing, etc., during July, August, and September is too great to warrant using CCC on cuttings taken before early July.

Pinched Plants

1960 Tests

Some plants from California were pinched two weeks after potting which was the day the CCC was applied. These were handled as described

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for the single-stemmed plants and each plant was pruned to two stems. There were four pots of three plants to a 6-inch azalea pot shown in each treatment in Table 2.

TABLE 2.--PINCHED PLANTS AS AFFECTED BY CCC

Potting Date	Amt. of CCC Per 3" Pot	Treatment Date	Ave. Diam. of Bracts in Inches	Ave. Height of Plants Above Pot Rim in Inches
7/20	None	8/3	10.0	25.0
7/20	1/4 gram	8/3	9.2	20.3
7/20	1/2 gram	8/3	9.5	15.0
7/20	1 gram	8/3	8.7	11.6
8/3	None	8/17	10.0	18.7
8/3	1/4 gram	8/17	9.1	13.3
8/3	1/2 gram	8/17	8.3	11.6
8/3	1 gram	8/17	8.1	9.7
8/17	None	8/31	9.2	14.5
8/17	1/4 gram	8/31	6.6	7.5
8/17	1/2 gram	8/31	5.3	6.7
8/17	1 gram	8/31	----	----

The results were similar to those on the plants grown single-stemmed.

1961 Tests

It is apparent from observation of plants produced from cuttings from both California and those at Ohio State which are propagated in July and early August that CCC can be used any time up to the end of August if the pinch is made by that time. Plants pinched and treated after September 1 are not of good quality because they are so short. The $\frac{1}{2}$ gram rate per plant in the 3-inch pot is recommended.

Re-Treatment at Panning

1961 Tests

Re-treating the soil at panning is a promising method of continued restriction of internode elongation when roots grow into the newly added soil. If panned before late October, the roots will grow into the newly added soil and the upper internodes on the plants will elongate. From the observations to date, the use of $\frac{1}{2}$ or 1 gram per 6-inch pan (containing three single-stemmed plants) is not enough, and the 2 gram treatment shows pronounced, though desirable, effects on elongation. Plants given the first treatment as late as September 1 may benefit from re-treatment at panning to prevent undue internode elongation.

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"Massive" Doses

Some florists have used the system of allowing the plants to grow to nearly the desired height and then treat with a "massive" dose such as 2 grams or more per plant (not pot) when panned. Although observation of plants in several commercial establishments reveals that elongation has been markedly reduced or almost stopped in some instances, the effect of such large dosages on bract size remains to be seen. Judging from the 1960 tests where the largest doses (1 gram) per plant in a 3-inch pot applied late caused marked reduction in size, we would expect that something similar would occur from massive doses after panning. This, of course, would be highly undesirable.

Other Considerations

All of the above results are based on plants rooted in a propagation bench, potted, then treated. For those who root directly in pots, growth of the plants is much more rapid compared to cuttings lifted from a bench which injures the roots and checks the growth. Treatment of plants from cuttings rooted direct in pots can undoubtedly be made later than recommended earlier in this report.

Southern growers have had problems with "stretch" of plants for many years even when they purchase callused or rooted cuttings from California as late as delivery in mid-September. Treatment can probably be made using $\frac{1}{2}$ gram per pot up to late September, but the nationwide trials will reveal more precise information on this matter.

There is no doubt that CCC can be a boon to the poinsettia growers, and it is apparent that enough information is now available to permit the release of the material for use by the trade. Further refinements by both experiment station personnel as well as members of the florist industry are expected which will add greatly to the knowledge we now possess.

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RESPONSE GROUP CLASSIFICATION OF POINSETTIAS

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The chrysanthemum is the most important flowering pot plant today. Certainly the factor of greatest importance to this eminence is that with considerable accuracy, it is possible to flower a crop of chrysanthemums at any time of the year and have them be of good quality and of proper height.

The schedules available today from many sources make it possible for even relatively inexperienced growers to grow a crop and have it timed properly. It is true that individual growers must make adjustments in planting date or pinching date to control height; however, this is to be expected since management practices vary considerably between growers. It cannot be disputed, however, that published schedules are a necessity as guides to pot mum flowering.

Just as certain as schedules are necessary for quality plants is the fact that precise control of the factors affecting flowering is necessary in order to follow the schedules. The schedules, after all, resulted from knowledge about the influence of daylength, temperature, and other factors on flowering. The number of long days between planting and pinching or shading must be regulated precisely in order to produce good plants. As an example of the precise control and timing necessary, think of what would happen if Princess Ann were given one extra week of long days or were pinched one week earlier than the schedule dictates. Even one or two days are important. Precise control such as this pays off because most growers of good pot mums continue to light or shade, as the case may be, well past the date when it probably is no longer necessary. They cannot afford to take chances.

Although it is somewhat more complicated, pot mum growers go a step farther. They find it necessary to grow varieties of different response groups or different height treatments to flower at the same time because of market demands for variety, size, and quality. Even though more costly in terms of time and labor, the return apparently justifies it.

Consider for a moment what the situation would be if chrysanthemums were a flower grown only for one holiday in the fall. How many growers would return to the old "time pinching" method of regulating flowering and height to time mums for this holiday? Not many to be sure. The production schedules of today are too necessary to insure a quality plant when it is needed.

Now that consideration has been given to the pot chrysanthemum, let's turn to the poinsettia. Doesn't it appear reasonable that what has been said about mums applies equally to poinsettias? In the case of poinsettias there is even more reason for precise scheduling since keeping quality is

not generally as good. Enough is known about the effects of environment on poinsettias to make schedules as meaningful as those for chrysanthemums.

Before trying to outline a schedule for poinsettias, it would be well to consider some of the factors involved. On the positive side are: 1) schedules would be simplified considerably over mums because instead of 365 possible flowering dates to consider, there are only about 25 since the period from December 1 to Christmas is currently the only season of demand, 2) schedules would be simplified even more because of the limited number of varieties carried by any one grower. Three or four varieties--perhaps two reds, white, and pink--are about maximum for any one grower.

Complicating factors must also be considered. Among these are: 1) currently used varieties, though limited, vary considerably in "response", 2) different sizes of plants are required. Pot chrysanthemums are primarily sold in 6-inch pots; however, poinsettias are sold in pots ranging from 3 inches to 12 inches, or larger, and a range in height is usually necessary, 3) the "response" of poinsettias probably varies more with temperature than that of chrysanthemums and manipulating temperature is necessary for poinsettias, 4) most growers do not order poinsettia cuttings to "arrive" on a given day. They are faced with the problem of propagating their own plants and, as a result, considerable variation exists in the methods used.

It is certain that none of the above complicating factors are of such a serious nature as to prevent the classification of poinsettias into response groups and making practical use of such a classification.

On the basis of work already done with the effects of temperature and daylength "response group" classification can be proposed. Most information available concerns Barbara Ecke Supreme; however, enough is known to roughly indicate what is to be expected from some other varieties. Temperature must be considered in a poinsettia classification, whereas, it is not necessary with chrysanthemums.

TABLE 1

Tentative Response Classification of Poinsettia Varieties at Various Temperatures

Variety	Days to Flower After Start of Short Days 62°F	65°F	70°F
Barbara Ecke Supreme	75	70	60 1/
Ecke White 2/	80	70	60
Pink 2/	70	65	60

1/ 70°F response for Barbara Ecke Supreme based on use of black cloth shade for 3 weeks after start of short days since temperatures as high as 70°F tend to delay bud initiation. Since bud development is speeded, however, 70° is recommended for late plantings.

2/ Days to flower for Ecke White and Pink take into consideration the extra time necessary for these varieties to develop clear color and large bracts after the first flower is evident.

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Note that the emphasis of the above classification is placed on the time between the start of short days and flowering (for Barbara Ecke Supreme to flower December 20, we count back 75 days to October 6 to begin short days).

Nothing has been said about when cuttings should be made, planted, or pinched; however, the first step in planning a pot mum flowering would be the same as above. The second step in a mum program, after selection of variety and flowering date, would be to determine when to plant the cutting. With mums, both steps will have an effect on height. So it is with poinsettias. If we want 3-bloom poinsettias near 16 inches above the pot and if we grow Barbara Ecke Supreme at 62°F, experience has shown that one week of long days between the time the cutting is rooted and short days start is adequate. Thus, after cuttings "arrive" from the "propagator" (cuttings rooted) on September 28, they should be lighted until October 6. With poinsettias it must be assumed that the propagator is sending cuttings that have been kept vegetative by use of light just as is true with mums. If the grower does his own propagating, he can insure vegetative cuttings by the use of light from September 20 until the schedule calls for short days (lights out). It is the job of the propagator, in most cases the grower himself, to insure that stock is managed properly so that cuttings will be available September 7 so that they can be stuck to provide rooted cuttings on September 28.

To summarize the schedule:

Variety: Barbara Ecke Supreme
Size: 3-bloom, 6-inch, 16 inches high
Flower: December 20
Temperature: 62°F minimum nights
Light: September 20 to October 6
Cuttings Rooted: September 28
Cuttings: September 7

The above schedule could be carried even further to include pinches on the stock to insure adequate cuttings on September 7. Shearing pinches (all possible shoots soft pinched) would be made 5 and 10 weeks before September 7. If cuttings are taken, they would be removed 4 and 8 weeks before September 7 since hard pinches return near 1 week faster than soft pinches.

The "plant, shade pinch" and "delayed pinch" systems have come into wide use by pot chrysanthemum growers as a way of controlling height by, in effect, reducing the days each shoot grows before a flower is set. Although delayed pinching of poinsettias cannot be used if single stem plants are desired, the same principles of these systems can be applied in another way. Height in poinsettias can be controlled by delaying the "planting date" (the date cuttings are rooted). Late panning has been used as a means of reducing height but usually this is done by withholding water from cuttings taken early by keeping them in small pots. By delaying the "planting date" (the date cuttings are rooted) the number of long days may be reduced to 0 or the date of "planting" may even be delayed until after the start of short days. Such a schedule for shorter plants such as would be used for 3-bloom, 5-inch plants, 10-12 inches above the pot would be:

Variety: Barbara Ecke Supreme
Size: 3-bloom, 5-inch, 10 inches high
Flower: December 20
Temperature: 62°F minimum nights

Light: September 20 to October 6
Cuttings Rooted: October 10
Cuttings: September 20

Note that the above schedule calls for lights. Experience has shown that in a normal year this particular schedule does not need light; however, plants are not delayed by lighting. Since "normal years" are impossible to predict in advance, lights should be used for insurance. The only difference in the schedule immediately above and the one given previously is the number of long days between the date cuttings are rooted and the start of short days. In the first schedule 8 days were allowed and in the second, "planting" was delayed past the start of short days by four days. This kind of schedule has an advantage over use of late panning and other ways of reducing height in that less time is used and there is less labor involved.

Because of the demand for small plants, the need to utilize cuttings available after the "main season" propagations, and other reasons, even shorter schedules are useful. Below is one for single bloom 4-inch plants based on the information on days to flower and experience in how much "delay" is necessary.

Variety: Barbara Ecke Supreme
Size: Single bloom, 4-inch, 8 inches high
Flower: December 20
Temperature: 65°F minimum nights
Lights: September 20 to October 11
Cuttings Rooted: November 2
Cuttings: October 11

Note in the above schedule that planting has been delayed 3 weeks after lights out (stock plants were lighted). By removing long days from the schedule by "delayed planting" a shorter plant results. Note, too, the 65°F minimum temperature. It appears that this temperature is necessary for establishing the plant resulting from a late cutting. At 70°F faster, more uniform establishment results.

A schedule with the same total length employing higher temperatures and giving larger plants is presented below:

Variety: Barbara Ecke Supreme
Size: 3-bloom, 5-inch, 12 inches high
Flower: December 20
Temperature: 70°F minimum nights
Light: September 20 to October 20
Shade: October 20 to November 10
Cuttings Rooted: November 2
Cuttings: October 11

If 70°F temperatures are used, black cloth shade results in faster, more uniform flowering and reduces height considerably (see Table 1).

A great deal remains before schedules of this type can be put into use on the scale that pot mum schedules are used. One of the biggest problems is in propagation. Cuttings, with large leaf surface kept intact during rooting, rooted rapidly in small pots under intermittent mist, and correctly

hardened after rooting, are necessary for precision, fast-schedule growing. In the past, a similar problem existed with chrysanthemums and there is little reason to expect that current propagation problems will not be solved with similar results even if not in a similar manner. Delayed planting, however, will present somewhat greater problems.

It should be clearly stated that the schedules given are tentative and should not be taken at face value but should be used only as a guide.

Examples with other varieties have not been cited, but they would follow the same pattern. In most cases better results with much less time involved can be obtained by growing white and pink varieties at temperatures of 65°F or above. In order for colors to clear and bracts to enlarge at 60°F, whites and pinks require nearly as much or more time than Barbara Ecke Supreme. At 65°F and above, however, they are as fast or, especially in the case of pink, faster. Important, too, is the fact that white and pink root much faster than Barbara Ecke Supreme.

Emphasis is placed in this article on the necessity for precision scheduling methods to insure the desired product. Applying the same techniques to poinsettias as have been applied to chrysanthemums will inevitably result in faster schedules with savings in space and labor. A more complete report on poinsettia schedules will be made at a later time, but the time to start thinking about such schedules is now. The primary control over flowering date, height, quality, etc., will come from proper scheduling and management of plants according to schedules. Other means of controlling height, CCC for example, should be carefully considered as aids in attaining the desired end-product and not substitutes for proper management.

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POINSETTIA STOCK PLANT PRODUCTION

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Data below is based on 53 #1 Barbara Ecke Supreme stock plants; however, the figures were adjusted to represent 100 plants. Dividing each figure by 100 gives single plant production. The production between any two dates can be obtained by subtracting the accumulated total of the earliest date from the accumulated total of the latest date.

Date Cuttings Removed	Number Removed	Accumulation Total	Month	Total
June 30	330	330	June	330
July 10	189	519		
July 31	566	1085	July	755
Aug. 6	1095	2180		
Aug. 11	189	2369		
Aug. 15	472	2841	Aug.	1756
Sept. 1	566	3407		
Sept. 7	94	3501		
Sept. 8	264	3765		
Sept. 9	2480	6245		
Sept. 15	566	6811		
Sept. 22	151	6962		
Sept. 29	735	7697	Sept.	4856
Oct. 6	283	7980		
Oct. 13	283	8263		
Oct. 20	226	8489		
Oct. 27	226	8715	Oct.	1018

Plants were received in early April, 1961, potted in $\frac{1}{2}$ bushel baskets (one bushel baskets would reduce watering time considerably) and maintained at 70° F minimum night temperatures in unshaded greenhouses. Pinches were made when shoots had at least two mature leaves and were made twice weekly until July. July 15, five to ten pinches per plant were made and on July 20 and 25, three to four pinches per plant were given. Additional pinches were made to prevent gross overgrowth of individual shoots if cuttings were not taken.

Soluble fertilizers were applied at each watering, from the time shoots appeared, at the rate of $\frac{1}{2}$ pound of 20-20-20 per 100 gallons of water. Additional weekly applications of 3 pounds of 20-20-20 per 100 gallons of water were started in late June and maintained through October. All cuttings were taken to leave two mature leaves below the cut. Four-inch cuttings were made and all pinches were soft.

Fig. 5. Photographed December 9, 1959. The unlighted plants are showing stamens. Flowering data showed that these plants were in flower December 6. The unlighted plants are developing quite rapidly.

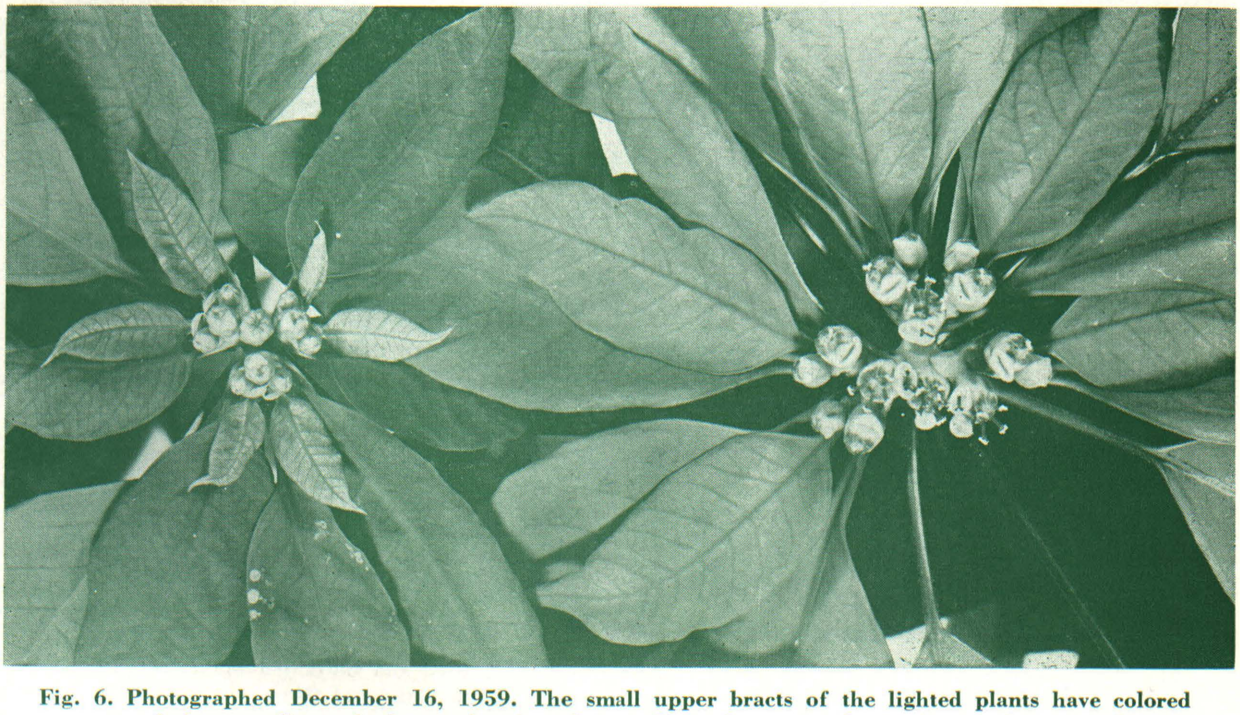

Fig. 6. Photographed December 16, 1959. The small upper bracts of the lighted plants have colored and the true flower buds are the size of peas. Note the nectar beginning to form on the unlighted plants.

Fig. 7. Photographed December 23, 1959. Note that the stamens are just ready to "pop" in unlighted plants while they are much in evidence in unlighted plants. Many have fallen, also, in unlighted plants and this will mean a messy situation for the customer.

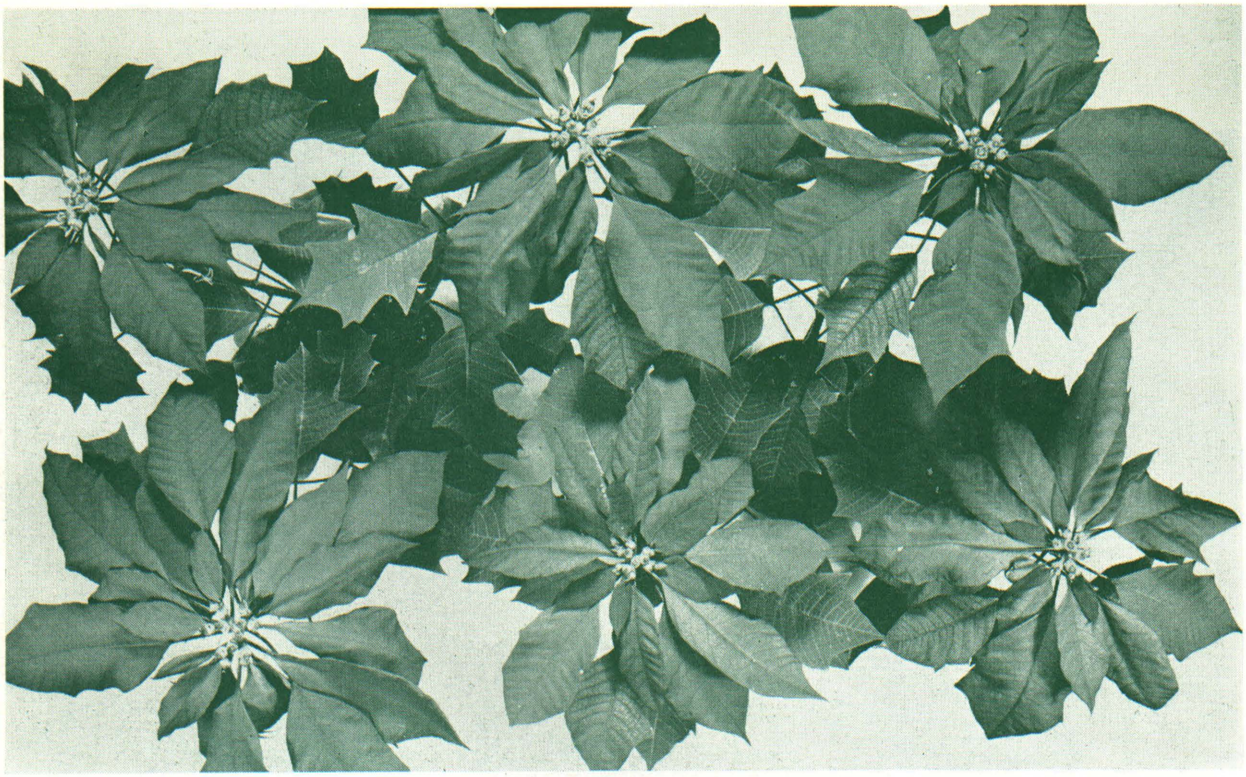

Fig. 8. Photographed December 23, 1959. This shows both lighted and unlighted plants in full. Note the tight bracts of the lighted plants (upper row, plant at right and lower row, plant in center and at right) while those of the unlighted plants are starting to get loose and open because of the expanding flowers in the center.